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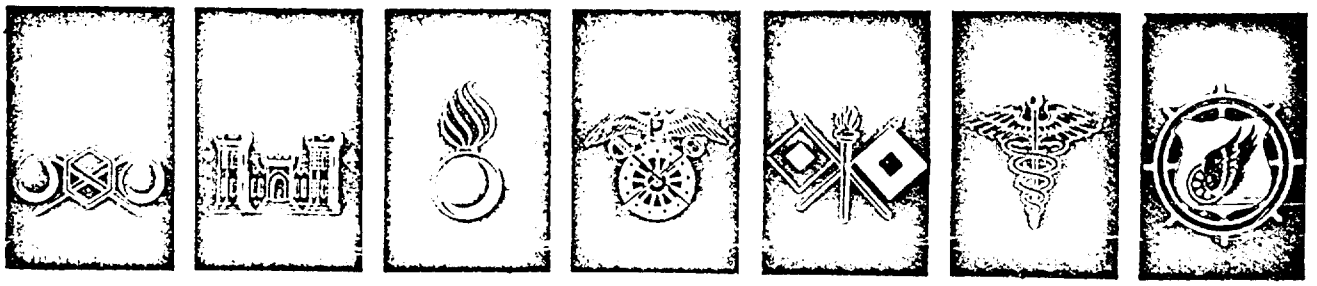

SESSION A-VI-4

TITLE: A Basis for the Long Range Planning of Army Research

AUTHOR: McCLURG
Army Research Office

ABSTRACT: Increased interest in improving the functions of Army long range planning and technological forecasting has prompted an investigation to determine in what ways and to what extent the planning of basic and applied research can be a meaningful and useful activity for the Army. It appears that straightforward planning methods can be adapted to the planning of research, but that existing statements of operational requirements are not suitable as goals for research planning. A skeleton outline representing the basic operational capabilities needed by an Army should be a useful tool for the research planner and technological forecaster in making use of available long range operational guidance. Problems faced by the Army in this kind of planning and forecasting will be varied and formidable, and will require a high degree of a new and specialized technical competence, which the Army must develop and utilize.

A BASIS FOR THE LONG RANGE PLANNING OF ARMY RESEARCH

G. H. McCLURG
RESEARCH PLANNING DIVISION
ARMY RESEARCH OFFICE
WASHINGTON, D. C.

I. PURPOSE.

The investigation upon which this Paper is based was undertaken in order to determine in what ways, and to what extent, the overall planning of Army research can be a meaningful and useful activity; to produce a rationale or guide for research planning; and to indicate how such planning may be oriented toward the long-range interests of the Army. This Paper is intended to present a discussion of some results of this investigation to date, principally on the nature of research planning in general and on the possibility of relating it to operational goals.

II. WORD MEANINGS.

Dictionary definitions of the words "plan", "program" and "schedule" are not helpful, even for a qualitative inquiry. For the purposes of this discussion, the following meanings will be adopted:

PLAN: A guide to decisions on actions which are to produce desired results in the future. A Plan will include guidance for the allocation of resources to needs.

PROGRAM: A specific allocation of resources to needs, such as a research program for a particular Fiscal Year. A Program is derived from an R&D Plan by the application of particular input data and the exercise of judgment in evaluating criteria and carrying out the decision process.

SCHEDULE: A specific allocation of resources toward meeting a particular requirement over a period of time, such as a schedule of expenditures for a research project from year to year.

III. SCOPE.

Within the area of Army Research, several kinds of planning can occur, depending on what is being planned. This discussion will be limited to planning the scientific and technical content of research programs. It will not be concerned with fiscal planning aimed at obtaining the money resources needed to implement a proposed research program, or with financial management planning aimed at the orderly commitment and expenditure of money on research projects, so as to best conserve and utilize these resources within the applicable laws and regulations. All planning considerations not requiring scientific assessment of program content will be considered here as potential limitations or boundary conditions affecting the freedom of action of the scientific planner. Only basic and applied research are being considered, exclusive of supporting research for specific development contracts.

IV. PLANNING AS A PROCESS.

Since the determination of the scientific content of a research program is obviously a "process" of some sort, we might approach research planning by considering the plan for a process in general:

A. Assessment of resources.

B. Formulation of needs.

C. Comparison of resources with needs, using a language expressing the basic goals of the organization for which the plan is being devised, so that its problems (needs) can be matched to potential solutions selected from the set of resources.

D. If resources are insufficient, the Plan should provide guidance for improving resources or the methods of applying them, or for decreasing or simplifying needs, so as to obtain a balance.

E. If resources are still insufficient, then theories of value and cost must be applied so that a "best" allocation of available resources to the most important needs can be made.

F. Any final inability to meet minimum needs will be reported to a higher organizational level, where more resources may be available for allocation or where more alternatives may be open in reducing or modifying needs.

Even though this outline seems much too definitive to apply to research, scientific administrators must be using some such form of decision process, and it may be worthwhile to make comparisons.

V. THE PLANNING OF RESEARCH.

A. Resources.

At the input to the research process, resources are in the form of information, in the scientific literature and in the minds of research scientists. Output is also information, but higher in quality or quantity, better organized, or more useful. Eventually, this information becomes a part of the "state-of-the-art". Diffusing from person to person and into the permanent records of science, it forms the basis for new or improved technologies which enable the Army to improve its abilities. The assessment of research resources, therefore, does not seem to be a conceptual difficulty, although it faces the major problem of how to classify, abstract, store, retrieve and utilize scientific information, as well as the problem of how to efficiently utilize the capabilities of creative scientists through existing bureaucratic organizations.

B. Needs.

The formulation of needs or goals against which to consider or assess the relative value of proposed research efforts is a more difficult problem. Army research is undertaken with the intent of increasing the Army's capabilities, but existing statements of operational and equipment objectives seem inappropriate as goals for research planning. Some research guidance can be obtained by analyzing the existing requirements for new weapons systems to see where additional applied research may be needed, but little guidance can be expected from this source on how to assess the military implications of the more basic kinds of research which will lead to weapons system concepts of the future.

C. Comparison of Resources and Needs.

At present, there is a strong and increasing interaction between the rapid evolution of methods of warfare and the exponential advances of science and technology. This suggests a dual approach to Army research planning, in which each significant scientific advance would be related to all the basic Army operational capabilities which it might improve and each needed operational capability would be related to all the resources of science, both present and predicted. However, there is considerable difficulty in making these associations directly between the language of science and that of officially-approved statements of Army operational requirements. The latter need to be reasonably specific in order to form the basis for specific actions, while fundamental scientific discoveries often have broad military implications. It

may be desirable for Army research planners and technological forecasters to key their activities to an informal language in which a more fundamental list of Army operational capabilities can be compiled. It may be possible to construct such a list to represent all the basic operational needs of an Army, regardless of changes in warfare methods, world conditions or the status of science.

D. Army Operational Capabilities.

In determining what kind of entities might make up such a list, several characteristics seem to be important:

1. Long Useful Life.

a. Avoidance of military operational terms which imply specific tactical or organizational concepts, since these may change rapidly.

b. Clarity and definitiveness sufficient to resist the establishment of artificial similarities between distinct operational functions.

2. Operational Purity.

Terms descriptive of pure function or operation, with no words such as "radio communication" or "vehicular mobility", which imply a particular technological method of accomplishing the function.

3. Logical Completeness.

Entire outline to include all the basic operational needs of an Army. List to be reasonably expandible, in whole or in part, to attain greater detail, without illogical overlapping.

4. Semantic Effectiveness.

Universality of interpretation or impact of the words used on the people who can be expected to use them, regardless of organizational level.

5. Heirarchical Logic.

All logical alternative methods of attaining a particular operational capability to be equally obvious at each point of the outline.

6. Simplicity.

List to comprise no more than 3 or 4 heirarchical levels, and to use a minimum of coined words or common terms having

special meanings.

E. Use of Operational Capabilities List.

An adequate list of this kind could be used to classify both (1) the existing statements of Army requirements and (2) technological forecasts and proposed research programs, thus bringing the Army's research needs and potential resources together for consideration. If a considerable scientific potential were to appear in support of an operational capability for which there was no formally-stated need, the planner could investigate to see if an unrecognized requirement existed; or, if a stated need seemed to have no potential scientific solution, a special search could be made for one, or for some alternative.

F. Example of Operational Capabilities List

One of several ways of constructing such an Army Operational Capabilities List is illustrated in Fig. I. This is based on the assumption of 3 major capabilities needed by an Army: Force-producing elements, the information and communications needed to use them intelligently, and the ability to control environment and maintain support for continued operations. The element of Force consists of capabilities for physical destruction, the ability to apply threats based on Force, and the ability to neutralize enemy force elements by essentially non-violent means. The factor of Responsiveness represents the ability to obtain and utilize information, to make combat decisions accordingly and to communicate combat information needed in Army operations. The Endurance factor is involved with providing the conditions for human effectiveness in combat, with the utilization of passive defense, and with the provision of general support needed for continuing operations: power sources, military construction, logistics, general purpose information systems and the like.

Other approaches to building such a capabilities list are possible, a number of these have been tried, and more ideas along this line from Army scientists interested in research planning will be welcome. The principal requirements are to make the set of categories complete and easily separable, so that all Army operational capabilities will find a logical place in the list; to use words which are purely operational or functional in nature; and to keep the list reasonably short and simple, so it will be easy to use.

G. Values, Costs and Criteria.

1. Of the recent publications on military logistics and development planning, one of the most useful is Charles Hitch's book "The Economics of Defense in the Nuclear Age"(1) His discussions of the criterion problem and of incommensurables and uncertainty point out the dangers of an oversimplified approach to the

estimation of values and costs. In planning research, these concepts are more subjective than for development, but they should be considered regardless of the uncertainty. Useful criteria of value might include:

a. Degree to which the research is related to an operational requirement, its probable effectiveness in helping to meet the requirement, and the relative importance of the requirement with respect to others.

b. Proven ability of the investigator, relative importance of the work within its scientific area.

c. Nature of the work, whether it represents a minor extension of a well-known field or a pioneering effort in a new and relatively unknown area.

d. Breadth of applicability: whether results are likely to affect one discipline only or to have broad implications in many scientific fields.

2. For research, scales of cost can probably be merged with those of value, with the cost of a research effort represented by the (negative) value of giving up an alternative use for the resources involved. It may be useful to first divide the field intuitively into three parts:

a. High pay-off or promise, low cost.

b. High promise, high cost, or low promise, low cost.

c. Low promise, high cost.

Items in category a. can then be included, those in category c. excluded, and the decision process applied only to group b. If there is a budget ceiling and if the values of individual items affect each other, it may be necessary to reconsider the value of the selected items as a group, after the allocation has been made. The absolute as well as the relative values and costs may be significant and require consideration as upper or lower limits to the decision process. Probable rate or acceleration of progress may be a factor in new or exploratory areas.

H. Organizations, People and Motives.

Research characteristically involves a greater ratio of individual effort to team effort than development. Research scientists, as a group, tend to be individualistic, personally creative and deeply ego-involved in their work, and their effectiveness is likely to be adversely affected by the frustrations

encountered in a bureaucratic environment. Since the effectiveness of research is sensitive to organizational factors, the research planner will need to seriously consider the possibility of improving organization for research in order to upgrade the value of research resources. The question is worth a more extended discussion than can be given here, and References (3) (4) and (5) are recommended. There have been two main trends in Organization Theory, a traditional approach based on organization as a method of controlling and directing behavior, and the more modern view of organization as a method of effectively coupling the abilities of individuals to the achievement of organizational goals. The latter seems better adapted to research management, but the bureaucratic structure which became firmly established during the early days of the first Industrial Revolution, the rise of specialization and of mass production, still presents a major difficulty between the creative scientist and the scientific administrator. Perhaps the best answer is in a dual system: the scientists as individuals or small-group workers to provide the creative personal contributions and the scientific administrators as a coordinated group to provide the conditions necessary for creative work and to arrange to utilize the scientific output for the Army's benefit.

VI. CONCLUSIONS.

A. The overall planning of Army research can be a meaningful and useful procedure, and normal planning methods can be adapted to the purpose.

B. For use in research planning, a permanent list of Army operational capabilities can probably be constructed, which will provide a more direct and fruitful link between the resources of science and the long-range interests of the Army.

C. Technological forecasting and research planning are new and important disciplines requiring the development of a specialized professional competence within the Army.

References

(1) Hitch, Charles J. and McKean, Roland N., "The Economies of Defense in the Nuclear Age", RAND Corporation Report R-346, March 1960.

(2) Klein, Burton, "A Radical Proposal for R&D", FORTUNE, May 1958, pp. 112 ff.

(3) Haire, Mason, (Ed.), "Modern Organization Theory", Wiley, New York, 1959.

(4) Argyris, Chris, "Understanding Organizational Behavior", Dorsey Press, Homewood, Ill., 1960.

(5) Merton, R. K., et al, (Eds.), "Reader in Bureaucracy", Free Press, Glencoe, Ill., 1960.

FIG. I

ARMY OPERATIONAL CAPABILITIES